LENGTH OF ADAPTATION PERIOD : INFLUENCE ON DIGESTIVE EFFICACY IN RABBITS

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Abstract - A collaborative study was undertaken to investigate the influence of the length of adaptation period on digestive efficacy in rabbits by using 2 diets differing in their DE content in a 2 x 2 experimental design. After a 7-day or a 14-day adaptation period, nutrient digestibility was determined on 7-week old growing rabbits according to the European reference method. On the whole, 70 digestive balances were carried out on the basis of 16 to 19 rabbits per treatment. No influence of adaptation time on nutrient digestibility was observed regardless of the diet.

INTRODUCTION

A great disparity exists between laboratories in methodology used for digestibility trials in rabbits. Notably, the length of the adaptation period is usually inconsistent: 4 days (TAG-EL-DEN *et al.*,1988), 7 to 14 days (PEREZ *et al.*, 1994), 10 days (XICCATO & CINETTO, 1988), 14 days (AYERS *et al.*, 1992; GARCIA *et al.*, 1992). In Europe, efforts have been made recently to standardize the digestibility procedures (PEREZ *et al.*, 1995a) and some research teams have decided to adopt a common method (PEREZ *et al.*, 1995b). This European reference method recommended at least 7 days of adaptation to the diet before the collection period, but as yet data are lacking about the consequences of variation in the adaptation time on digestibility results in rabbits. The aim of this work was to compare two lengths of adaptation period (7 days *vs* 14 days) by using two diets differing in their digestible energy (DE) content in a 2 x 2 experimental design. The experience was undertaken at two sites with common diets.

MATERIAL AND METHODS

Diets

Ingredient composition and chemical analysis of the experimental diets are given in table 1. Diets were formulated to have a moderate (M) or a high (H) digestible energy content (DE). Diet M contained a high proportion of fibre sources (lucerne meal, beet pulp), while diet H included more starch-rich ingredients and was supplemented with dietary fat.

Digestibility trial

The balance trials were carried out at the experimental facilities of two French feed manufacturers (SANDERS and GUYOMARC'H). Nutrient digestibility was determined on growing rabbits by using the European reference method (PEREZ *et al.*, 1995b). Californian x New Zealand White rabbits were kept individually in metabolism cages at weaning *i.e.* at 35 or 31 days of age according to the site of experience. The animals weaned at 31 days were given *ad libitum* access to the pre-weaning mother diet for one additional week. At 35 or 38 days of age, rabbits were allotted on the basis of 9 or 10 per treatment by taking into account their live weight (avg: 1042 ± 6 g) and the origin of litters . They were divided into 4 groups: group 1 received *ad libitum* diet H for one week and then diet M for 2 consecutive weeks (*i.e.* rabbits were subjected to a 7-day period of adaptation to diet M before the collection period) while group 2 received diet M from the beginning of the experience (*i.e.* rabbits were subjected to a 14-day period of adaptation to diet M before the collection period); group 3 and group 4 differed respectively from group 1 and group 2 only by substituting diet M for diet H. After a 7-day (groups 1 and 3) or a 14-day adaptation period (groups 2 and 4), *i.e.* at 49 or 52 days of age

according to the site of experience, total faecal ouput was collected for 4 consecutive days; faeces produced daily were put in individual plastic bags and stored at -18°C for further analyses.

Table 1 : Ingredient composition and chemical analysis of experimental diets

Diet		M	H
Ingredient (%)			
Barley meal		9,90	18,50
Dehydrated lucerne meal		30,10	10,00
Wheat bran		20,00	27,40
Beet pulp		12,00	4,70
Sunflower meal		19,40	19,00
Peas		-	5,00
Soybean meal		-	3,70
Soybean oil		-	2,20
Animal fat		-	1,00
Cane molasses		6,00	5,00
Calcium carbonate		0,43	1,82
Dicalcium phosphate		0,90	0,33
Salt		0,60	0,61
L-lysine-HCl		0,11	0,12
DL-methionne		0,06	0,12
Trace minerals and vitamins mix		0,50	0,50
Chemical analysis			
Dry matter	(%)	88,1	87,9
Ash	(% DM)	9,7	8,9
Crude protein	"	17,8	19,5
Ether extract	"	2,6	5,7
Starch	"	16,2	21,5
Crude fibre	"	19,4	14,5
NDF	"	38,5	33,8
ADF	"	22,1	16,9
ADL	"	5,8	4,2
GE	(MJ/kg DM)	18,27	18,86

Chemical analyses

Dry matter (DM), ash, crude protein (CP), ether extract and Weende crude fibre (CF) contents were determined according to the methods of AOAC (1990). Starch content was measured using the Ewers polarimetric method (EEC, 1972). Cell wall fractions (NDF, ADF, ADL) were determined by a sequential procedure including an amylolytic pretreatment (VAN SOEST *et al.*, 1991). Gross energy (GE) was measured by isoperibol bomb calorimetry.

Statistical methods

The experimental data were analyzed by ANOVA using the GLM procedure of SAS (SAS, 1988). Statistical model included the effects of diet, adaptation time and the interaction between diet and adaptation time. Since no effect of experimental site and no interaction between site and treatment were observed these effects were discarded from the model.

RESULTS AND DISCUSSION

Dry matter intake (DMI) recorded throughout the experience is given in table 2. Our data indicated that only a short adaptation time to diet is necessary for rabbits to adjust their feed intake. High correlation exists between DMI recorded during the 2nd week and that observed during the collection period ($r = 0.86$ and 0.91 respectively for diets M and H) even so for rabbits not receiving their experimental diets previously (groups 1 and 3). Moreover, DE intake during the collection period, when expressed per unit of metabolic body weight, is not influenced by the length of adaptation period (1.12 MJ/kg $BW^{0.75}$). These findings are in agreement with previous results showing a rapid change ($\approx$ one week) in feed consumption after diet switching (LEBAS *et al.*, 1982; GIDENNE *et al.*, 1991). However for both diets, variability of feed intake during the collection period was reduced for rabbits subjected to a longer adaptation time (CV = 10.7 *vs* 15.0%). The same trend was already observed during the 2nd week.

Digestibility results are given in table 3. Regardless of the diet, nutrient digestibility and DE content were not affected by the length of adaptation period. Furthermore, the higher variability of feed intake recorded with rabbits subjected to the 7-d adaptation period has no adverse effect on the accuracy of digestibility measurements. On the contrary, the variability of digestibility results tended to be more important with rabbits receiving their experimental diet for a longer time.

Finally, our results obtained in large conditions (two opposite diets x two experimental sites) demonstrate that a pre-experimental period of only 7 days prior to collection period is adequate for rabbits in digestibility trials. Accordingly, dry matter digestibility of rabbit diets can be achieved at short notice (2 weeks at the most) by using the European reference method which includes a 4-day collection period.

Table 2 : Dry matter intake (g/d)[1]

Diet	M		H		Level of significance [2]		
Adaptation time	7d *n=17*	14d *n=19*	7d *n=18*	14d *n=16*	D	A	D x A
1st week	113,2 [3] ±3,2	114,1 ±2,0	114,8 [4] ±2,8	109,1 ±2,8	0,22 [5]	-	-
2nd week	129,6 ±4,0	133,4 ±3,8	136,4 ±4,7	129,6 ±4,1	0,72	0,72	0,21
3rd week (collection period)	146,6 ±5,4	152,8 ±3,7	147,4 ±5,1	141,8 ±3,9	0,27	0,95	0,20

[1] Mean ± Standard error
[2] D : diet effect ; A : adaptation effect ; D x A : diet x adaptation interaction
[3] Rabbits were given diet H during 1st week
[4] Rabbits were given diet M during 1st week
[5] Contrast : Groups 1+4 *vs* Groups 2+3

Table 3 : Effects of diet and adaptation time on nutrient digestibility and digestible energy content[1]

Diet		M		H		Level of significance [2]		
Adaptation time		7d *n=17*	14d *n=19*	7d *n=18*	14d *n=16*	D	A	D x A
dDM	(%)	63,43 ±0,27	63,07 ±0,48	67,68 ±0,39	67,47 ±0,55	<0,001	0,52	0,87
dOM	"	63,49 ±0,27	63,16 ±0,48	68,25 ±0,40	67,99 ±0,55	<0,001	0,50	0,96
dGE	"	62,60 ±0,27	62,26 ±0,48	68,10 ±0,42	67,90 ±0,55	<0,001	0,54	0,87
dCP	"	73,93 ±0,44	74,00 ±0,46	78,79 ±0,49	78,33 ±0,88	<0,001	0,74	0,65
dCF	"	22,74 ±0,58	22,17 ±1,05	19,99 ±0,72	19,88 ±1,17	0,007	0,71	0,80
dNDF	"	34,13 ±0,46	33,52 ±0,90	34,21 ±0,75	33,73 ±0,96	0,86	0,49	0,94
dADF	"	23,65 ±0,86	22,89 ±1,15	21,65 ±0,78	21,42 ±0,99	0,077	0,61	0,78
DE	(MJ/kg DM)	11,43 ±0,05	11,37 ±0,09	12,85 ±0,08	12,81 ±0,10	<0,001	0,54	0,88

[1] Mean ± Standard error
[2] D : diet effect ; A : adaptation effect ; D x A : diet x adaptation interaction

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REFERENCES

AOAC, 1990. Official methods of analysis (15th Ed.). Association of Official Analytical Chemists, Arlington, VA.

AYERS A.C., CHEEKE P.R., PATTON N.M., 1992. Evaluation of hybrid poplar leaves as a feedstuff for rabbits. *Proc. 5th World Rabbit Congress*, Corvallis, Oregon, USA, 25-30/6/1992, **vol. B**, 1033-1042.

EEC, 1972. Analytical determination of starch. *Official Journal of European Communities*, L123/7.

GARCIA G., GALVEZ J.F., DE BLAS J.C., 1993. Substitution of barley grain by sugar beet pulp in diets for finishing rabbits. 1. Effect on energy and nitrogen balance. *Proc. 5th World Rabbit Congress*, Corvallis, Oregon, USA, 25-30/6/1992, **vol. B**, 1008-1016.

GIDENNE T., SCALABRINI F., MARCHAIS C., 1991. Adaptation digestive du lapin à la teneur en consituants pariétaux du régime. *Ann.Zootech.*, **40**, 73-84.

LEBAS F., LAPLACE J.P., DROUMENQ P., 1982. Effets de la teneur en énergie de l'aliment chez le lapin. Variations en fonction de l'âge des animaux et de la séquence des régimes alimentaires. *Ann. Zootech.*, **31**, 233-256.

PEREZ J.M., BOURDILLON A., JARRIN D., LAMBOLEY B., LEBAS F., LE NAOUR J., WIDIEZ J.L., 1994. Application de la méthode européenne standardisée de mesure *in vivo* de la valeur énergétique des aliments destinés au lapin : comparaisons inter-laboratoires. *6èmes Journ. Rech. Cunicole Fr.*, La Rochelle, 6-7/12/1994, pp. 365-374. ITAVI Ed., Paris.

PEREZ J.M., CERVERA C., FALCAO E CUNHA L., MAERTENS L., VILLAMIDE M.J., XICCATO G., 1995a. European ring-test on *in vivo* determination of digestibility in rabbits : reproducibility of a reference method in comparison with domestic laboratory procedures. *World Rabbit Sci.*, **3**, 171-178.

PEREZ J.M., LEBAS F., GIDENNE T., MAERTENS L., XICCATO G., PARIGI-BINI R., DALLE ZOTTE A., COSSU M.E., CARAZZOLO A., VILLAMIDE M.J., CARABAÑO R., FRAGA M.J., RAMOS M.A., CERVERA C., BLAS E., FERNANDEZ J., FALCAO E CUNHA L., BENGALA FREIRE J., 1995b. European reference method for *in vivo* determination of diet digestibility in rabbits. *World Rabbit Sci.*, **3**, 41-43.

SAS, 1988. SAS/STAT User's Guide (Release 6.03). SAS Institute Inc., Cary, NC, USA, 1028 p.

TAG-EL-DEN T.H., MERVAT A.A., MOLNAR J., 1988. Effect of restricting feeding periods on feed intake and digestibility of dry matter in rabbits. *Proc. 4th World Rabbit Congress*, Budapest, Hungary, 10-14/10/1988, **vol. 3**, pp 213-222.

VAN SOEST P.J., ROBERTSON J.B., LEWIS B., 1991. Methods for dietary fiber, neutral detergent fiber, and non starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.*, **74**, 3583-3597.

XICCATO G., CINETTO M., 1988. Effect of nutritive level and age on feed digestibility and nitrogen balance in rabbit. *Proc. 4th World Rabbit Congress*, Budapest, Hungary, 10-14/10/1988, **vol. 3**, pp 96-103.

Influence de la durée de la période d'adaptation sur l'efficacité de la digestion chez le lapin en croissance - Un même schéma factoriel 2 x 2 a été mis en place dans deux sites expérimentaux pour évaluer l'influence de la longueur de la période d'adaptation sur l'utilisation digestive de deux régimes différant par leur concentration énergétique. Après une période d'adaptation à l'aliment expérimental d'une durée de 7 ou 14 jours, la digestibilité apparente (MS, MO, énergie, azote, cellulose brute, NDF, ADF) a été mesurée chez des lapins âgés de 7 semaines en appliquant la méthode européenne standardisée. Au total, 70 bilans digestifs ont été mis en oeuvre à raison de 16 à 19 lapereaux par traitement. Aucune influence de la durée d'adaptation sur la digestibilité des nutriments n'a été mise en évidence quel que soit le régime alimentaire.
